

DOCKETED

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IN THE UNITED STATES DISTRICT COURT FOR THE
SOUTHERN DISTRICT OF NEW YORK

Midway Manufacturing Company :
vs. :
The Magnavox Company : 74 Civ 1657 CBM
and : Deposition of William
Sanders Associates, Inc. : T. Rusch, 3rd day

IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF ILLINOIS, EASTERN DIVISION

The Magnavox Company et al :
vs. : Consolidated Actions
Bally Manufacturing : 74 C 1030
Corporation, et al : 74 C 2510
75 C 3153
75 C 3933

FILED

OCT - 8 1978

H. STUART CUNNINGHAM, CLERK
UNITED STATES DISTRICT COURT

Continued deposition of William
T. Rusch taken pursuant to subpoena and notice at

ERNEST W. NOLIN & ASSOCIATES
General Stenographic Reporters
369 ELGIN AVE, MANCHESTER, N. H. 03104
TELEPHONE: 623-6906

the office of Sanders Associates, Spit Brook Road, called a South Nashua, New Hampshire, on Wednesday, February and Bally, 25, 1976, commencing at 10:00 o'clock in the forenoon.

was excused and testified: PRESENT:

Interrogated by: For Midway Manufacturing Company and Bally Manufacturing Corporation:

Q. I'd like to review, Corporation: status of the T.V.

game project at the time Donald L. Welsh, Esq. and Mr.

beer to work on that For Sanders Associates and Magnavox Company:

recalling that as of that time apparatus had been developed James T. Williams, Esq.

for playing a game on a television set and that one

For Sanders Associates:

of the game involved generation of two rectangular

spots or dots, each of Louis Etlinger, Esq., and and Richard I. Seligman, Esq.

horizontally and vertically For Atari, Inc.: son manipulating

knobs which controlled Edward S. Wright, Esq.

correct? Stenotype Reporter:

A. Yes, I believe so. Barry G. Nolin, C.S.R.

Q. And for moving each rectangular image or dot were there not two potentiometers, one for changing the vertical position of the image and one for changing the horizontal position?

A. I believe so.

Q. Was there, also, circuitry for causing one of the images to disappear whenever the two images overlapped?

or coincided: WILLIAM T. RUSCH

called as a witness in behalf of Midway Manufacturing Company and Bally Manufacturing Corporation, being first duly sworn, was examined and testified as follows:

(Interrogatories by Mr. Welsh) or to change when the

Q. I'd like to review, Mr. Rusch, the status of the T.V. game project at the time when you first joined Mr.

Q. Baer to work on that project. Do I understand correctly that as of that time apparatus had been developed for playing a game on a television set and that one of the games involved generation of two rectangular spots or dots, each of which was movable, movable horizontally and vertically, by a person manipulating

Q. knobs which controlled potentiometers, is that correct? ending to work on the T.V. game project?

A. Yes, I believe so. remember exactly. It seems to me

Q. And for moving each rectangular image or dot were there not two potentiometers, one for changing the vertical position of the image and one for changing the horizontal position? have changed, but I'm not definitely

A. I believe so. when that feature got into the act.

Q. Was there, also, circuitry for causing one of the images to disappear whenever the two images overlapped

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or coincided? (try include the rest of the background)

A. I'm not sure of that. There may or may not have been. I am quite sure, at least in the rifle shooting game, that there was a mechanism for either making the spot disappear or the background color to change when the gun hit the target. In view of going through this notebook yesterday --, that electrical signal was

Q. That's Exhibit 16. I can't remember exactly. As

A. I guess. Let's see. Yes, Exhibit 16. I don't think we found that kind of coincident^{ce} circuitry up through that date, and to answer your question strictly from memory, I'm just not sure. I think^{and} there may have been such circuitry, but I'm not sure. I wonder whether

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Q. Was such circuitry developed or in existence prior to your commencing to work on the T.V. game project?

A. That's what I can't remember exactly. It seems to me in that version that existed when I got there, in a chase game where one spot chased the other, that when this did overlap, one might have disappeared and/or the screen color may have changed, but I'm not definitely certain just when that feature got into the act.

Q. Apart from the feature of disappearance of one of the spot images upon overlap or coincidence of the images,

did the circuitry include the feature of the background changing color upon overlap or coincidence of the spot images? *yes, perhaps.*

A. I can't remember that. It's pretty much the same thing. If you generate an electrical signal with overlap,

A. you can either make a spot disappear or color change.

Q. Whether or not, indeed, that electrical signal was

A. generated at that time I can't remember exactly. As

I say, I do remember fairly clearly such a signal was happening when the gun was aimed in such a fashion as to hit the target spot on the screen, but as far as overlapping of the spots, generating ^{one}, I'm not sure.

Q. And is it correct that you do not remember whether any provision was made for detecting overlap or coincidence in the apparatus that was in existence in the T.V. game project when you joined it? *apparently,*

A. That's correct. *change phenomenon* happening when the

Q. Did you have anything to do -- strike that. *just* you may be looking for That was a feature that became a part of the T.V. game apparatus ^{at some time}, was it not? *is turned on, and the red characters disappear*

A. Yes. the color field changes from green to solid red

Q. Did you have anything to do, personally, with the

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origination of that feature?

A. I don't remember. I'd have to look through lab

A. notebooks, perhaps. in the lower part of that page.

Q. Referring to pages 44 and 45 of Exhibit 15, do you find there any reference to coincidence of two dots?

A. Yes. color, is that correct?

Q. And what is that? said that. It's still true. I seem

A. On page 44, at the top of the page there seems to be a description of a problem caused when two spots overlap. Let's see. I take that back. Apparently, that problem was caused by the horizontal D.M.V. being varied. That, apparently, is an effect which would happen with one spot. Now, at the bottom of that page,

Q. 44, however, there does seem to be either a problem or what Mr. Harrison called a phenomenon occurring when the two characters were coincident. It, apparently,

A. involves a color change phenomenon happening when the two signals do overlap. I think the main point you

may be looking for would be at the bottom of page 45,

where it says, "Via coincident^{ce?} gate the timing circuit^{wtr}

S.C.R. is turned on, and the red characters disappear

as the color field changes from green to solid red,

except for the blue characters, which remains." The

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date on that page is 5/24/67.

Q. Is there a coincidence circuit shown there? T.V. game

A. There appears to be in the lower part of that page.

Q. I believe you stated that you seemed to remember that in a chase game in the first demonstration background changed color, is that correct? Any time as a feature

A. I believe I just said that. It's still true. I seem to remember it happening, but I'm not a hundred per cent certain. My memory seems to definitely recollect things like that happening in the rifle shooting game, and having seen this circuit, now, on page 35, I would say it is more probable that it also happened when two

Q. spots overlapped. The question is not what the exhibit

Q. Do you have any recollection of your suggesting that the overlap or coincidence of two spot images be detected electrically?

A. After having seen this circuit on this page, I'd say

Q. probably not. I might qualify that a bit. It is possible I did. I don't -- I am looking now at this Exhibit 9-51 through 9-63. I don't know if that specifically covers anything like that in this memo by particular memo. I may have suggested this in talks with Ralph Baer somewhere through this project, but

I don't really remember.

Q. Have you considered it an improvement to the T.V. game project which you contributed?

A. I was at one time, MR. WILLIAMS: I object to the question as being not fixed to the time. This patent.

Q. Were you familiar MR. WELSH: At any time as a feature which he contributed. scribed in that patent around the

time the application THE WITNESS: I don't know. I

A. notice in this Exhibit 9-51, for example, under 5,

Q. "Maze game" it says, "If the 'rat' hits a line of a maze, it disappears and reappears back at starting point." So I don't really know.

Q. (By Mr. Welsh.) The question is not what the exhibit refers to, but whether you have felt that that was a feature which you contributed to the T.V. game development?

A. I'd say probably not, but it is possible. badly does,

Q. Are you familiar with Baer patent No. 3728480 which is one of the earlier T.V. game patents that's been marked as Exhibit 10?

(Document handed to the witness by Mr. Welsh.)

Q. What would you say THE WITNESS: Let's see. I've seen

A. this before, yes. It then is a matter of how important

Q. (By Mr. Welsh.) Are you familiar with the T.V. game and circuitry described in it? as the addition of the

A. I was at one time, I believe. It's been, maybe, three, four, five years since I've read this patent.

Q. Were you familiar with that circuitry in it and the T.V. game apparatus described in that patent around the time the application was filed? or, to the best of

A. Which was when? It involved, I believe, a two-diode

Q. The original application on which that was based was filed January 15, 1968. a saw wave form and did the same

A. Yes, I believe so. a saw wave by changing the voltage of

Q. Do you recall whether that apparatus includes the feature of detecting coincidence of two spot images?

A. You want me to recall before I look at this? end of the

Q. Yes. This timing change, obviously, corresponded to

A. All right. I don't recall. It quite probably does, but I'm not sure. a saw wave. This electronic control of

Q. Do you feel that you have, after you joined Mr. Baer on the T.V. game project, made any contributions to the T.V. gaming development? as definitely one of my

A. I think so. as to this project, and after seeing the

Q. What could you consider to have been your contributions?

A. I will try to list them in order of how important they are or they were, and I may forget some, but I'll do the best I can. I think the addition of the feature which allowed electronic control of spot position as opposed to the purely manual control that existed when I joined the project was an important feature. That came as a result of a different method for moving spots which I thought of, to the best of my recollection. It involved, I believe, a two-diode slicer which effectively sliced out a portion of the saw-tooth horizontal sweep wave form and did the same thing on the vertical sweep by changing the voltage or voltages to which the diodes were connected. The slice effectively could be moved in time from early, in the sweep cycle to later on or the other end of the cycle. This timing change, obviously, corresponded to a position change, because the spot occurred while the slice was being taken. This electronic control of spot position opened up a whole new field of games that could be played. I feel that one such game, which I call the ping pong game, was definitely one of my contributions to this project, and after seeing the number of people around this country playing it, I

feel it was, perhaps, one of my most important contributions to the project.

Another game which required some further circuitry and invention which I consider that I contributed was a so-called hockey game. This and all similar games of such a nature that they required what I used to call wall bounce, I feel were made possible by a contribution of mine which made it possible for a moving spot to reflect from either the side of the T.V. set or any designated area with an angle of -- excuse me -- with an angle of reflection equal to the angle of incidence of the spot on the T.V. screen. Of a somewhat similar nature was another feature I contributed which I consider major, and that involved certain actions which one spot would take after being hit by another spot. This involved the hit spot moving in the same direction which the hitting spot had when the two spots touched each other. It also involved the hit spot moving at an initial velocity proportional to that of the hitting spot when the two spots touched. This action was somewhat -- or more than somewhat -- it did, indeed, implement one of the games I had originally conceived back in May,

1967, as shown in Exhibit 9-61, item 18. In the last sentence of that item mentions a ball or a puck moving away from a man like a ^{Kicked} ~~kick~~ball or a passed puck and allowed the man to nudge the ball along like a hockey player moving a puck with him. That is, if the player spot was moving very slowly when the second spot was hit, the second spot moves ^d slowly, etc.

Another contribution which I feel I made included a maze game with a numbered overlay which fastened in front of the T.V. screen. The numbers were in squares. I arrived at this method of developing a maze because of the rather small size of a T.V. screen when compared to the size of an easily visible spot. A normal, more obvious maze just using lines for the walls or channels would have been too simple and too easily accomplished by the player to be very interesting. The numbered squares permitted what I called an even-odd movement plan, in that one player was permitted moves only in such directions which would make the sum of the number he was moving to and the number he was moving from be an even number. The other player was allowed to move so that the sum of his two numbers was odd.

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Later on in the project I contributed another feature which I believe is covered in a separate patent. As I recall, it involved being able to point at the T.V. set with a photocell-type device somewhat similar to that used in the target shooting game, the point being to have the gun affect some of the spots but not all. For example, perhaps ^{w/2} one out of three spots might dis- ^{5/25/76} appear when the gun was aimed at it. For the record, ^{punct.} I believe Ralph Baer conceived of the desire for doing this, and I contributed the technical method. I remember this quite clearly.

Just to cover things, we also had another, simpler version of a hockey game which, technically, was very similar to the ping pong game in that two spots represented players and the third spot which had been a ball in the ping pong game now represented a puck in this smaller, economical, two-man hockey game. I would say, at least, some of the items in Exhibit 9-51 through 9-63 and, possibly, all of them were my -- some of my contributions to the project. I've heard since that a roulette wheel type game has developed in other versions of these games.

That's listed in rather simple form as item 8 in Exhibit 9-53. I haven't really followed this project closely for the last few years. I don't know if any of those other ideas in that exhibit ever bore fruit. I believe this covers most of what I consider my most important contributions to this project.

MR. WELSH: Let's take a break.

(Whereupon, at 10:55 o'clock, A. M., a short recess was taken.)

AFTER RECESS - 11:05 A.M.

Q. (By Mr. Welsh.) During the recess, Mr. Rusch, you indicated that you had some further statements to make in answer to the last question?

A. Thank you. This may be superfluous, but variations on the hockey, ping pong games made possible by electronic control of spot position and/or velocity and direction, and the wall bounce feature, I feel, were one of my contributions to this device. I use the word superfluous, because I think most of them were written up in the separate patent which, eventually,

was issued to me. I forget just what the number of that patent was. I believe most of these games were covered in that.

Q. Is it correct that the feature which you consider your most important contribution to the T.V. game development was the addition of a different method of moving spots allowing electronic control of spot position?

A. Being more technically oriented than of legal mind, I would say just the concept of wanting to do this was, perhaps, the most important rather than the exact nature of this sliced wave form method, which happened to be the first way it was implemented. Also, whether that was more important than just the concept of the ping pong game with two players, two player spots and a ball, I wouldn't really know.

Q. Referring to the concept of the ping pong game with two players and a ball, could you be more specific as to what constituted that concept and what was new about it that had not been done before?

A. Before I joined the project?

Q. Before you conceived of it.

A. Before I conceived of it. I'd say, primarily, the

motion of the ball after being hit demonstrated this feature which I consider important. The motion of the two paddles just moving up and down in a vertical column was implemented in a way that was not really new or different from the spot control that was in existence before I conceived of the ping pong game. However, when the ball touched one of those specific spots, it did, indeed, bounce toward the other side of the screen demonstrating electronic spot control.

MR. WELSH: Could I have that last sentence, please?

(The last answer was read back by the reporter.)

Q. (By Mr. Welsh.) When you said that, primarily, the motion of the ball after being hit demonstrated the feature you considered important in the ping pong game, did you mean the so-called bounce toward the other side of the screen after the ball touched a player?

A. Yes, in that prior to this contribution, if the two spots touched, one disappeared or the screen color changed, but this bouncing motion was a new feature, I think.

MR. WELSH: Could I have that last sentence there, also?

(The referred-to portion of the last answer was read back by the reporter.)

Q. (By Mr. Welsh.) Prior to your concept of the ping pong game, how many spots were used or generated in playing the T.V. games?

A. I think from what I've seen in the exhibited material here in these last few days there were, probably, at least two. There may have been more, I don't recall.

Q. With respect to at least the two spots which you recall having been present prior to your ping pong concept, were those two spots movable in a manner similar to the movements you contemplated in the ping pong game?

A. Definitely not when considering the motion of the ball in the ping pong game. They were similar to the motion which the motion of the paddles in the ping pong game, that motion being strictly up and down governed by a human hand turning the knob of a potentiometer.

Q. You did not contemplate in the ping pong game that the paddles could also move horizontally as well as up or down?

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A. Yes, we had a feature for moving them either in closer to the middle of the screen or further away, but this was not a continuous operation. The reason for that was that for inexperienced players and, therefore, a slower game, if the column of motion of the paddles was moved to the outside extremities of the screen, it would take longer for the ball to bounce from one paddle to the other, thus making a slower game. Obviously, if the columns, the motion of the paddles, were moved in nearer the center, the distance and time of the bounce from one paddle to the other was shortened making for a faster game for more experienced players.

Q. In games prior to your ping pong concept, was there any image corresponding to the wall image in the ping pong game?
Note: Probably should be ball.

A. I don't think so, and I say this because I do believe there was no provision at that time for electronic control of a spot's motion. Therefore, there could be no bounce or associated movements of a ball-type spot.

Q. In the original portion of your statement of what you consider you contributed, you referred to electronic control of spot position vs. purely manual control which existed at the time you joined the T.V. game

project. You went on to say that the specific circuitry involved a slicer for slicing out portions of the saw tooth wave form of the horizontal and vertical sweep signals. Did that concept come first, or what led to -- let me ask, first: did that concept come first?

A.

Would you repeat that?

(The last question was read back by the reporter.)

THE WITNESS: I'll try to rephrase, or, rather, phrase my understanding of the intent of the question. As I understand it, the question is: did the idea of using the sliced wave form or the idea of electronic control of spot position come first? I can't recall, but I believe they were, probably, simultaneous, somewhat like the chicken and the egg question. I believe I must at the time have realized that if this diode slicer scheme did prove feasible, that it would be very easy to ⁿⁿ correct the diodes to variable rather than fixed voltages, and, obviously, doing the latter would provide electronic control of spot position and velocity and direction.

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Q.

(By Mr. Welsh.) Do you recall the circumstances under which the idea -- either of electronic control or the

using a sliced wave form came to you?

A. Well, I was in close association with Bill Harrison in that room where this device was being developed. I was aware of the problems involved and the solutions that were then existent, and I guess one day the thought just came to me that it might be nice to open up a whole new field of possibilities by trying to get electronic control, and the idea of this sliced wave form also just happened to come to me as one method of accomplishing that.

Q. Do you recall the problems involved in the solutions then existing that you just referred to?

A. Well, one problem which we have been discussing is that the spots could be controlled only manually at that time.

Q. Do you recall any others?

A. Well, of a less related nature, there was the problem of the sensitivity of the rifle, and in the target shooting game, and whether or not fluorescent lights bothered it, things like that. There are always economic considerations, search for simpler, cheaper circuits which might do the same job with a few less transistors, components.

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Q. Do you recall whether your concern about the problems and your coming up with the concept of electronic control had anything to do with your taking a more active part in the T.V. game project, perhaps, as a result of funding having been obtained?

A. I think it may have caused me to take a more active role just from a pure personal interest standpoint, that these ideas had come to me, and I wanted to see if they would, indeed, work. I have no recollection whether or not this changed funding or not.

Q. I hand you what have been marked as Exhibits 26-4, 5, 6 and 7, and this document refresh your recollection

to this regard? (Documents handed to the witness by Mr. Welsh.) MR. WILLIAMS: I have.

Q. (By Mr. Welsh.) I ask if you recognize those, and, if so, would you tell us, 26-4, 5, 6 and 7?

A. All right. I'm now looking at 26-4. This page appears to be a plan submitted by the equipment design division of Sanders Association, Inc., for a continuation of the T.V.G. special display techniques, dated September 15, 1967. Exhibit 26-5, in that it happens to be attached to the previous exhibit, appears to be a schedule

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associated with it, and Exhibit 26-6 which, again, by itself, wouldn't mean much to me, but being it is attached to these two exhibits, appears to be a schedule of man months and cost; and Exhibit 26-7 would appear to be the last page connected with this plan, and I do see my name and Ralph Baer's listed as principal investigators. I see that I, apparently, signed that on 9/28/67, so I would say that this does appear to be a request that the project continue and, as shown in Exhibit 26-6, that that amount of money shown there was requested to continue this project.

Q. Does seeing this document refresh your recollection in this regard? proceed on this I.V.C. special dis- techniques task. MR. WILLIAMS: In what regard?

MR. WELSH: As to whether funding was, in fact, obtained.

THE WITNESS: It refreshes my memory in that funding was, apparently, requested as shown by this exhibit. I don't remember whether it was obtained or not.

Q. (By Mr. Welsh.) Did you have anything to do with the preparation of this document, Exhibits 26-4 through 26-7?

A. I don't know. I, obviously, must have seen it, because I signed it, but whether I prepared it, myself, or helped prepare it I can't recall. To get back to what I believe was your previous question, I have noted at the bottom of Exhibit 26-7 H. W. Campman, Jr., signed this paper on -- it says -- on 10/5/67 next to a statement "Approved by --" according to that, it would seem like he had approved the funding requested in this document.

Q. Referring to Exhibits 26-2 and 26-3, are those familiar to you?

A. They do, indeed, appear to be an authorization from H. W. Campman to proceed on this T.V.G. special display techniques task.

Q. Your name is among those listed under distribution, 26-2, is it not?

A. That's correct.

Q. Do you recall receiving this document?

A. No, I don't.

Q. I believe yesterday you stated that the first entry which you could find in your notebooks, specifically, Exhibit 17, was with respect to T.V. games, was on page 95?

A. I believe that's correct.

Q. And the date on that page is September 25, 1967, is it not?

A. That's correct.

Q. And the date of the next entry on page 96 is September 28 or 29, I guess September 29, 1967?

A. September 29, correct. For something less important.

Q. Those dates fall between the date of September 15, '67, of 26-4 and are very close to the date of your signature of 9/29/67 on 26-7 and just before the date of approval of Mr. Campman of October 5, 1967, on Exhibits 26-2 and 26-7, are they not?

MR. WILLIAMS: Well, I object to the question "very close." The term is very vague. The dates are there and they speak for themselves. The witness' characterization of what those dates are close to each other and their relationship doesn't seem to be very relevant.

Q. (By Mr. Welsh.) Do you understand the question?

A. I believe so. Let me rephrase it to see if I understand it. Are the dates of 9/25/67 on page 95 of Exhibit 17 and 9/29/67 on page 96 of that exhibit very close to the date 9/28 at which time I, apparently,

had signed Exhibit 26-7 and the date of 10/5/67 when Mr. Campman, apparently, signed Exhibit 26-2, is that correct, my understanding of the question?

Q. Yes.

A. Well, not trying to be too wise, I'd say 9/28 is within one day of 9/29. If you were catching a plane, it would be a long time. For something less important, it wouldn't be a long time. I tend to say it depends on how one is defining very close. That, obviously, is one day apart. The 9/25 date on page 95 of Exhibit 17 precedes 9/28 by three days, and I would say the same thing, in effect, my counsel has, that the dates speak for themselves.

Q. Earlier I asked if your activity leading to your concept of electronic control of spot movement came as a result of funding obtained for the T.V. game project. I ask you, now, if seeing these documents refreshes your recollection in this regard?

A. I don't remember that question. Did my conceiving this idea for electronic control--

Q. No, did your activity leading to the concept come as a result of this apparent funding as represented by the documents in Exhibit 26?

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A. As I understand the question, I don't think so. I think it is probable that the idea preceded this request for continuation of funding.

Q. Did your activity with respect to amount of time spent on the T.V. game project increase after this funding approval?

A. I don't remember.

Q. Would your notebooks reflect whether it did or not?

A. Possibly. In a certain this way, yes.

Q. Could you examine your notebooks and tell us if that occurred, that is, your activity increasing after the funding? (n.) And during what period?

A. Well, the last few pages of Exhibit 17 starting at the bottom of page 95 and continuing to the last page, page 100, appear that, at least, appear to show that, at least, the items recorded in that particular lab notebook were more directly applicable to T.V. games than previous items recorded.

Q. Were they applicable to anything else?

A. Probably to many things, but that was not the extent of them, as I recall. (n.) I believe.

Q. They relate to your work on the T.V. game project, do they not?

A. Yes.

Q. And how about the entries in your next notebook, Exhibit 18?

(Document handed to the witness by Mr. Welsh.)

THE WITNESS: I have just gone through Exhibit 18. I forget the exact question that was asked, but I can say that unless I've missed a few items in examining this exhibit, this particular notebook does, indeed, seem to be devoted exclusively to T.V. games.

Q. (By Mr. Welsh.) And during what period of time does that notebook cover?

A. 10/18/67 through 11/29/67.

Then in parenthesis MR. WELSH: "Let's break here for lunch. By X-ray shots for dentists, etc." (By Mr. Welsh.) These pages still (Whereupon, at 12:00 o'clock,

noon, a recess for lunch was taken.)

We seem to be back to games, T.V. games, specifically

(BY MR. WELSH: AFTERNOON SESSION 1:30 P.M.)

Q. (By Mr. Welsh.) Mr. Rusch, I believe you indicated the last few pages of Exhibit 17 and all of Exhibit 18, your notebooks, relate to T.V. games, Exhibit 18

containing material dated from October 18, '67, to 11/29/67. Now, I hand you Exhibit 19 and ask would you please tell us what portions, if any, of that notebook relate to T.V. game work by you, and, if so, what dates those notes bear?

(Document handed to the witness by Mr. Welsh.)

10-13/67 and THE WITNESS: Well, pages 1 through 23 appear directly involved with T.V. games. I see I made a note on page 24 up at the top that this wouldn't necessarily have to be concerned with games. Apparently, the time is shown on page 25. I was looking for other uses for this, for these techniques. I see. I have "Use in banks and stores, in hospitals." Then in parentheses "Display electrocardiogram, display X-ray shots for dentists, etc." Obviously, these pages still would refer to the same kind of techniques that I had been working with. On page 26 we seem to be back to games, team games, specifically.

Q. (By Mr. Welsh.) What were the dates of pages 1 to 23?

A. Page 1 is dated 11/29/67. Page 23 isn't dated, but appears to be a continuation done on the same day as page 22 which is dated 12/11/67. All the pages

in between are not dated, but I would believe they were chronologically done. I don't see any blank spaces. Page 21 is blank. Let's see, do you want me to continue now?

Q.

Yes.

A.

We were on page 26 which seems to be more games. That page is dated 12/13, probably 1967. I see on page 28, dated 12/13/67 and on page 29 as, apparently, still looking for other uses for these techniques, specifically, at the top of page 28 is mentioned designing furniture placement, office locations, drawing silhouettes, etc., in color.

Page 30 has an idea outlined in blue with some stars around it which I referred to previously, the idea for T.V. team hockey which I had noted might sell to bars and clubs. The bottom of page 30 seems to be some completely different idea involving some sort of a mechanical toy with an airplane flying around as a crank is cranked mechanically.

Page 31, 12/18/67, involves something not related to T.V. games, specifically, some kind of an arrangement with a mirror to, apparently, help piano players play more easily.

Page 32, as it says at the top, is, apparently, a search for more categories. I see part-way down that page a sentence, "Invent new kinds of games." It has an idea about half-way down the page to use a T.V. as an oscilloscope which is, probably, not directly related to the T.V. games we've been talking about. I think that involved a belief that whereas an oscilloscope and a T.V. set both contain cathode ray tubes that hobbyists could use their home T.V. set as an oscilloscope by by-passing the R.F. section.

The top of page 33 is, apparently, more casting around for new ideas, different products not specifically or exclusively games. The bottom of page 33 is a statement back to team-type games.

The top of page 34, again, seems to be an attempt to look for more possible uses of the techniques that had been developed so far in fields other than just games. I see I wrote down "educational, communication, designs, drawing."

Q. This was still contemplating the same techniques that you developed for the games?

A. Well, it doesn't really say here. I think it is

possible this was more blue sky-type thinking, which if I had come up with some communication idea, whether or not it used those techniques, I might have pursued it. I don't really remember to answer that question exactly. I see on the middle of page 34 an idea that I, apparently, liked well enough to circle it in blue. "Pinball with scoring column." This, I believe, was to use some of the electronic techniques that had been under development.

Q. Would it be correct that at least from September 25, 1967, the date of the first entry regarding T.V. games in Exhibit 17 until December 11, 1967, on page 23 of Exhibit 19 which you are now going through and including all of the entries in your notebook, Exhibit 18, that the entries between those dates in your notebook all related to the T.V. game development?

A. I believe so, unless we missed one or two or a few going through there. I think, primarily, they do.

Q. Now, following page 23 of Exhibit 19, you've noted some other uses for the techniques. When you said "these techniques," did you mean the techniques that you had developed for T.V. games?

A. These entries following page 23 seem to indicate a

search for both type of products, those which were based on the T.V. game techniques as well as many others that might have appeared.

Q. There are continuing entries relating to the T.V. games beyond page 23, are there not?

A. Yes.

Q. And is there any point in the book where there are no longer any T.V. game entries?

Perhaps to help you a little bit, I call your attention to page 59, that reference to frequency halver. Was the frequency halver referred to there concerned with T.V. games?

A. No.

Q. That was related to the guitar development, was it not?

A. Yes, guitar and other instruments.

Q. Are there any T.V. game entries subsequent to that page 59?

A. What page was that, now, we started with?

Q. 59.

A. Page 59. Unless I've missed some items, I don't think there are entries in this particular notebook, Exhibit 19, related to T.V. games after page 59.

Q. And that page is dated January 31, 1968?

A. Correct.

Q. What's the date of the last entry in Exhibit 19?

A. 3/1/68 on the inside back cover.

Q. Do you recall terminating your work on the T.V. game project at any particular time?

A. Yes, I recall it being terminated. I don't know exactly when.

Q. Do you recall the circumstances under which your work on the T.V. game project was terminated?

A. I would say most work of a technical nature terminated after I transferred from Mr. Baer to Mr. Goulder's department. After that transfer, I think, any work I did on that might have involved, oh, signing patent releases for other countries, things of a semi-legal nature, but I don't remember doing any more real technical work on the project after that time.

Q. Would you tell us again, please, when you left Mr. Baer to go to work for Mr. Goulder?

A. I can't tell you. Again, I don't remember for sure.

Q. Approximately?

A. I believe it was in the fall of -- of a year later than -- well, I'm not even sure of that. It might

have been the fall of 1969 or earlier.

Q. Was there any reduction in your activity with respect to T.V. game development prior to the time that you left Mr. Baer's department?

A. I would say yes.

Q. That would be reflected in your notebooks, probably, wouldn't it?

A. Yes.

Q. In other words, from the period at the end of September until at least the middle of December all of your notebook entries related to T.V. games, and then subsequent to that they began to relate to other items?

A. Yes.

Q. And is that not an indication that you ceased working on T.V. games full time, at least?

A. I think it is. Somewhere in through that period there were patent write-ups. I don't remember exactly when they occurred, whether they were done simultaneously with this work after January 31, '68, or before. I imagine we can find out.

Q. Do you recall whether a stop order was placed with respect to the NKM project that Mr. Campman authorized

to be funded in October, 1967?

A. I don't recall.

(Document handed to Mr. Welsh by the witness.)

Q. (By Mr. Welsh.) Referring to what has been marked previously as Exhibit 26-1, do you recall receiving or being advised about that stop order on or about the date January 31, '68, that it bears?

(Document handed to the witness by Mr. Welsh.)

THE WITNESS: I don't specifically recall. I would assume I had either received a copy of this or had been told about it.

Q. (By Mr. Welsh.) You are shown on the distribution list?

A. Correct.

Q. And that coincides with the date of your last entry with respect to T.V. games, does it not?

A. It appears to be right around that time. I can't really find dates on the last T.V. entry, which appears to be on page 58 of Exhibit 19.

Q. And that's the page preceding the page dated 1/31/68?

A. Correct.

Q. And I believe you stated beyond that page you did not find any entries relating to work on T.V. games?

A. That's right.

Q. Do you recall doing any development work on T.V. games after that date?

A. I'm not sure. I do think after that date I did get into this guitar project. In trying to implement that, and without seeing subsequent material I can't remember exactly whether I got back into the T.V. game area or not, specifically development.

Q. I believe you stated that you recalled that subsequent to that date you might have prepared patent papers or you signed patent papers?

A. I may have, yes.

Q. Did you have anything else to do with T.V. game development such as demonstrations to other persons after that date of January 31, '67.

MR. WILLIAMS: '68.

MR. WELSH: Excuse me, '68.

THE WITNESS: What was the date?

Q. (By Mr. Welsh.) January 31, '68.

A. As I remember, not on any large scale. I don't think I ever went out on the road with the equipment.

I seem to vaguely remember a demonstration for some cable television people, and I think I may have helped prepare for that one, but it was not any real large scale development on my part.

Q. Do you have any specific recollection of any involvement on any scale?

A. You mean of other demonstrations other than that one?

Q. Other demonstrations or any other activity on your part with respect to T.V. games?

A. Not really. Again, I hate to rule out possibilities categorically on things that happened so long ago. As I remember the situation, I understood from talking with Bill Harrison that demonstrations were being given periodically to various T.V. manufacturers. I think that Mr. Baer and, possibly, Mr. Etlinger handled the negotiating part of those demonstrations, and they would seem to take Bill along in case the equipment became faulty as well as for him to help demonstrate it, of course.

Q. Now, referring back to your contributions to the T.V. game development and your addition of the feature allowing electronic control of the spot position, when did that concept first occur to you?

A. This is the concept of the electronic spot control?

Q. Yes, and if you find it necessary to refer to the books, I would like, also, to have you be looking for the first time the game of ping pong, specifically, occurred to you and, also, the concept of wall bounce?

A. To try to zero in on the electronic control question, I see on page 98 of Exhibit 17 and on page 99 of that same exhibit what may be one of my earliest entries involving the slicing of the sweep wave form to change spot position. I see a note which I, apparently, wrote on page 98, which, I think, may be involved with moving the spots electronically. The note is dated 10/23/67, and it talks about varying the voltage at which the slicer passes the ramp. Variation of this voltage would be a way of moving that spot. Whether that's exactly what I meant by this comment, I will try to find out.

Q. Did this page 98 contain an indication of some other method that you contemplated other than slicing the saw tooth?

A. You mean for moving the spots?

Q. Well, your entry on page 98 of Exhibit 17 dated 10/23/67 says, "Can also do by DC coupled saw tooth to slicer

diodes and then vary voltage at which slicer passes ramp." It says "Can also do --" Is there some other way contemplated?

A. Oh, what that means is, if you refer to the top of page 98, you will see a 15,750DC Hertz saw tooth generator shown as a box, and it is coupled through capacitors to boxes labeled variable DC spot 1H and variable DC spot 2H. All right. That, then, is indeed a way of positioning the spot. In that particular example the slicer diodes would go to a fixed voltage and, as shown in the little pictures I drew on page 98, the saw tooth wave form or wave forms, themselves, would have DC components added to them to raise them either up or down. This would indeed change the time at which slicing occurred. Now, the note in red where it says "Can also do by DC couple saw tooth" is effectively another way of doing the same thing.

Q. Now, you have another entry in red on the upper right-hand portion of page 98, do you not; not a written entry but another pictorial entry plus an asterisk?

A. I see two diodes shown there in the slicer in red. And an asterisk up in the top of the page 98, top right-hand corner, which, apparently, does refer to the

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asterisk in the left lower portion of page 98.

Q. Does that indicate that all the entries in red on that page were made at the same time? Can you tell that?

A. Probably, but not necessarily.

Q. Well, does the addition of the two diodes as shown in the slicer in the upper right-hand corner in red, is that consistent with the note in red dated 12/23/67?

A. Yes. I think the important point is that the slicing or the time at which slicing occurred could have been done as shown in the incorporated portion with capacitors in between the saw tooth generator and the wave form which is raised or lowered by a DC voltage then going to the slicer, and the note at the bottom, as I say, refers to another way of accomplishing this, where the saw tooth, itself, does not shift up and down in voltage, but instead, the slicer diodes or the slicing function is controlled from a voltage which does vary.

Q. I believe you were going to refer to page 18 of Exhibit 18?

A. Yes. In that on page 98 of Exhibit 17 the note in red also says, "See notebook 4958, page 18," which I will now look at, (at which I will now look.)

Page 18 of that exhibit, dated

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10/23/67, is entitled "Variable slice level," and the first entry refers back to these pages, 98 and 99, of the Exhibit 17 which we've been discussing. All right. I see a comment on this page 18 with a green asterisk after it. The comment says "Could also keep constant DC saw tooth and vary slice level," which is what I was just trying to explain before. The asterisk refers to another green entry at the bottom of page 18 saying, "Note, this great for many reasons. (Less loading of saw tooth, etc., etc.) Using the 10-30-67." This still doesn't seem to establish the use of a variable voltage to the diodes of the slicer for spot control, but it seems to indicate it. I see on page 18 of Exhibit 18 there is a point where two diodes are connected together, and I had drawn an arrow to that point with a comment "Low Z to AC, meaning low impedance to an AC variable voltage wave form." (The witness indicating on exhibit.) THE WITNESS: But also I see a variable resistor coming from that point to B. plus. I can't really tell from looking at this whether at that time I intended that that voltage be varied by changing that resistor or by actually hooking

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a variable voltage to that point, so I can't completely establish that function as yet.

I do see on page 28 of the same exhibit, 18, a drawing showing horizontal and vertical slice diode pairs going to points labeled variable horizontal slice level voltage and variable vertical slice level voltage respectively. So it would appear that the idea of putting any kind of a variable voltage there as opposed to one that was varied only manually may have been in thought at that time or was getting close to being born.

On page 35 is shown a method of moving four spots. That still appears to be controlling the voltage to the slicer diodes manually.

Page 36, dated 10/27/67, still appears to show manual control of the slicer voltage. One of the first instances I can find, now, of electronic control of spot position is shown on page 43 of Exhibit 18. Let's see, which does show slicer diodes being connected to a flip flop, and is, thus, an indication of one of the first instances I see of electronic control. On further perusal of this figure on page 43, it appears that what I was trying to do

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with that circuit was not to directly, and I emphasize it, not control spot position electronically in contrast to what I have just described. It is somewhat a question of semantics, but, apparently, the idea of this circuit was that when the flip flop was in one position, a potentiometer, which I labeled P1, for example, would have control of spot position in that the center arm of this potentiometer could be moved manually from a high to low voltage. With the flip flop in this state, the other potentiometer, labeled P2, would have no control. Then, when the flip flop was set the other way, control would pass from what had been the active potentiometer to the other one. This may have been part of the ping pong game. I can't really say at this time. We'll probably find out soon. I say it could be part of that game in that one of the functions in that ping pong game was that after player^A had hit the ball, and the ball starts bouncing back to his opponent, player A had a potentiometer with which he could control the vertical position of the ball and, thus, make it wiggle up and down and attempt to get it around his opponent's paddle. While the ball was in this flight just described, the second

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player's potentiometer should have no control over its flight. This circuit shown on page 43 does that.

2 Q. Was that control known as the English control?

A. I believe so, yes. It was the one normally operated with your left hand assuming you are a right-handed player who controlled paddle position with your right hand.

Now, on page 44 of Exhibit 18, the electronic control of spot position and velocity does really appear to rear its head in that the two diodes of the slicer are connected to an RC time constant, the R, or resistor, going to a flip flop. The idea here, apparently, being that when the flip flop switched from one state to another, the spot would change position in an exponential fashion with time. Further indication of electronic control is shown at the bottom of that page, 44. There is a comment in red, "For slow movement, instead of flip flops, use triggered saw tooth generator as page 42." I believe what I intended there as these words seem to indicate was that I didn't feel I could get a slow enough movement from the method shown on page 44 in that it would take, probably, extremely large capacitors and

resistors, so, apparently, I meant to connect the slicer diodes to what I call the triggered saw tooth generator, for example, the one on page 42, where operationally if a signal was given either manually, by pushing a button, or electronically to command the spot to move, the saw tooth generator would begin its sweep and change the voltage to the slicer diodes thereby causing the spot to move slowly horizontally or vertically or a combination of both. I see a comment on page 44 written in green to the right middle portion of page 44 that by adding another capacitor, which I call C1, a spot could, apparently, be made to overshoot its position, go off screen, out of view, and then drift back to position as capacitor C1 charged to its final voltage value. I made a comment, "This would be used for pumping action, etc." I feel that this is, this page, is a pretty good indication of electronic control at least being firmly underway by 11/1/67. Mr. Welsh, is that sufficient as far as trying to establish the electronic control part. Would you like to go on to the ping pong and the other items you mentioned or should we go further?

Q. Well, I'd like to have you go on to the other items.

I didn't know what the order of their occurrence was, and perhaps in looking for those, you'll find further indication of the electronic control.

A. Specifically, we're looking for electronic control, ping pong --

Q. And wall bounce.

A. -- and the wall bounce?

Q. Right.

MR. WELSH: Let's take a break.

(Whereupon, at 2:45 o'clock, P. M., a short recess was taken.)

AFTER RECESS 3:00 P.M.

Q. (By Mr. Welsh.) Would you like to have my last statement re-read, or do you recall where we were?

A. I don't know if it was yours or mine, but whoever, yes, let's find out where we were.

(The last question and answer were read back by the reporter.)

THE WITNESS: All right. I'd like to add a slight clarification. I was looking through

this Exhibit 18 during our recent break here. It does appear that the intent of the circuit on page 30 in that exhibit dated 10/26/67 was, indeed, electronic control of spots. Just before the break when I first studied that diagram I thought that the main feature of it was control of the spot manually through the pots shown as H1 -- excuse me, P1, P2, P3, and P4. That, indeed, was one of its functions, but the intent was more than that as shown by the red writing at the bottom of that page. By using these two flip flops, which, naturally, could be controlled electronically, the spot could be moved to four different positions. At the risk of being tedious, I will say, for example, if the left-hand horizontal flip flop was in a state such that H1 was ^{at} high voltage, then the spot would receive one horizontal voltage and, thus, stay in one horizontal position. At that same time, if the vertical flip flop shown at the right of page 30 were in one state, the spot would be at one vertical position controlled, for example, by P3, or when that flip flop was in its other state, the spot would be in another position as controlled by P4. Similarly, the vertical flip flop could be held in one

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of its states, and as the horizontal flip flop switched from one position to the other, ^{two} ~~the~~ horizontal positions would be obtained, thus giving four possible spot positions controlled electronically by pulses or other electronic signals which would control the states of the two flip flops. So it appears that at least on 10/26/67 electronic control of a spot was at least fully contemplated and, probably, being implemented.

Q. When you say "probably being implemented," what do you mean?

A. I mean that as shown here, the idea had been conceived and, probably, Bill Harrison and I either at that time or shortly thereafter attempted to reduce it to practice. I saw a note on one of these pages something or other was in use on 10/30.

Q. By implementing, then, you meant construction of the circuitry?

A. Yes. The note I was looking for is on page 18 referring to using something on 10/30/67. This page does show the slicer diodes, but does not, specifically, show them connected to a varying voltage quite as explicitly as is shown on page 30. Page 36, again, shows flip flop control of spot positions which is one of the

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first examples I find of that function.

Q. Now, does this work that you've been discussing involve any particular spot or just a spot and control of its position?

A. I think at that time it was, possibly, just a spot or spots in that if these ideas worked for one spot, they could be applied to other spots. Referring, again, to page 43 of Exhibit 18, which had been discussed earlier, I would say after further study that that, probably, does, indeed, show electronic control of a spot more than I had indicated earlier today. Indeed, it would give preferential control for manual positioning to one pot as opposed to the other. In addition, however, it can be seen that if the pots were left in one place but the flip flop electronically flipped, that the spot would move back and forth. Thus, it is also an example of electronic control as well as giving preferential manual control to one of several potentiometers. O. K. I see on page 45 of Exhibit 18 a note that this electronic control and use of the flip flops could have been tied into the target-shooting game. I think, in fact I am quite sure, that this would have been a new

feature at the time for that game in that, as shown in green at the bottom of page 45, if the gun was aimed at one spot and hit it, the flip flop would be made to flip and the spot would change position electronically.

110 Q. You say that's indicated at the bottom of page 45?

A. Yes.

11 Q. That indicates, does it not, that the spot would disappear?

A. It indicates both. The upper sentence says for positioning games let this pulse trigger the H and/or V flip flops. From that sentence it indicates that the pulse from the gun hitting a spot could be used to change the positions of that spot and/or other spots. Only one about three connections is there.

2 Q. Referring to the flip flop circuits on page 36 and 43 of Exhibit 18, do the flip flops cause the spot to move along a path or simply to jump from one position to the other depending on the setting of the potentiometers?

A. As shown by the rather clearly visible ink entries on page 36 --

Q. That's the entry to the right of the circuit?

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A. -- if, the circuit, itself, was mainly drawn -- it looks like -- with a ball point pen. As shown there, the spot would move rapidly from one position to the other when the flip flop flipped. The motion, possibly, being hardly discernible by eye depending on rise times of the flip flop. I see dimly in the background -- it looks like they may have been erased -- some capacitors. If capacitors, indeed, had been connected in that circuit, then the spot would have moved more slowly from one position to the other when the flip flop flipped, as I think we had indicated earlier with some other circuit diagram we talked about.

114 Q. And that's--that capacitor is located between the diodes and the potentiometer on page 36?

A. I vaguely see about three capacitors in there. It looks like I may have put them in initially and partially erased them. One seems to go from the center arm of the potentiometer to side A of the flip flop, another one from the center of the potentiometer to side B of the flip flop, and a third from the center of the potentiometer, and it seems to just hang out in air. I, probably, intended to go to ground to slow down the action. As I say, if you wish,

I know we discussed the circuit with time constants in there and flip flops earlier. We could find it if you like.

15 Q. No. That was on page 44, I believe, but I also had a question with respect to the flip flops or the flip flop of the circuit in page 43, whether when that changed from one condition to the other, the spots moved along a path or simply jumped from one position to another.

A. I would say it could do either, depending on the size of the capacitor, which in this figure is, indeed, shown in ink, apparently written with the same pen as the rest of the circuitry, said capacitor going from the junction of diodes to ground. A large capacitor there would, naturally, cause slow spot movement between one of two fixed positions; a small capacitor, rapid motion. I think I was at page 45. Shall I continue?

Q. Yes, please.

A. On page 49 I see some more work involving electronic control. It was, apparently, an attempt to control the spot position from a high impedance, and I see a note in the middle right of that page that it worked,

dated 11/2/67. Another note says, "But it doesn't seem as good as present low Z method due to spot fading." On page 50 seems to tie in with your previous question, Mr. Welsh, concerning how fast the spot moves from one position to the other with these various circuits. It was, apparently, an attempt to get a slower velocity between two fixed positions and was, apparently, possible using RC time constants. On page 51 I see a comment written in pencil, "This tended to work, but not with large C's," meaning capacitors, "for long T's," meaning time constants, but it does indicate attempts at electronic control, also, on 11/2/67. Pages 52 and 53 appear to be more work involving electronic control using flip flops. Page 54 is not specifically related to your question of electronic control, ping pong, or wall bounce, but I feel is worthy of attention to, at least, be discussed later in that it seems to be the first attempt made at automatically putting a ball back in play for application in various games where, for example, the ball has gone off screen. What this means is that instead of manually having to hit a reset button after the ball disappears, the players

could wait for a certain length of time, and the ball would automatically reappear into and onto the field of play.

Q. That was 53, you say?

A. No, page 54 of Exhibit 18.

Q. How did you contemplate doing that?

A. All right. Apparently, there was a free-running flip flop which would go from one state to the other after a time, shown as T, by itself, without external manual or electronic control. As I've indicated on that page with notes associated with the wave form shown, one state of the flip flop would result in the ball being off screen to the right, the other would put the ball off screen to the left, for example, obviously, the positions could be below the screen and above the screen as well. Thus, the ball, or spot representing the ball, would be off screen to the left, for example. After a time, T, it would appear on screen and either slowly or rapidly depending on the time constant used traverse the screen from left to right, if I'm following correctly what I'm saying, and go on the other side and go off screen on the other side. In normal operation, not really shown

on page 54, once the ball did enter the screen and was hit, for example, by a ping pong spot or hockey player spot, that spot would preempt control over this automatic reset function.

Q. At the top of that page there appear three stars with the word "major breakthrough"?

A. Yes, and an exclamation point. That was my rather immodest estimation of the importance of this.

Q. Automatic reset. Could you go on?

A. I see an indication, not specifically of wall bounce, but of bouncing in general shown on page 55, which is undated but was, probably, done between 11/13/67 and 11/15/67. There I indicated a bouncing ball. It is not indicated how this will happen, but at least I was thinking of it at the time. I might note that on page 56 I see a small picture of a badminton game which, I believe, was implemented later and, certainly, contains the same functions as the ping pong game for which we are looking in that a ball, or, in this case, a spot representing a badminton shuttlecock would bounce off a paddle, be controlled in flight by a player, traverse, in this case, over a net, and then be either hit or missed by the opponent's paddle

or -- what do they call them -- racket. The same badminton game is referred to on page 60.

Q. Referring to the top of page 56, the second sentence there states, "Now have three spot F. F. ball games." What does that refer to?

A. The F. F., naturally, refers to flip flop. It might refer to these games as having been implemented and proven feasible.

Q. Could you, by reference to Mr. Harrison's notes, determine whether there had been implementation of these ideas?

A. I will find out. Do you have another exhibit after this Exhibit 16?

Q. Exhibit 11 contains notes of Mr. Harrison. I am sorry. It's Exhibit 23.

(Document handed to the witness by Mr. Welsh.)

THE WITNESS: I have, perhaps, erroneously assumed that the material in this Exhibit 23 is arranged chronologically. I see the first page is dated 5/2/67. I have skimmed rather quickly through those first pages. I do see on Exhibit 23-106, dated 10/23/67, a crossed-out schematic,

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but importantly, above it are the words "Diode slicer." There may be other earlier indications, but this is, I think, one showing that Bill was attempting to implement this diode slicing idea I've referred to previously. I see on Exhibit 23-108 a diagram for a saw tooth generator using a PNP and an NPN transistor, which^{*} I feel I invented at the time of this project to provide saw tooth wave forms economically and at reasonable impedance for use in the diode slicing scheme.

Q. (By Mr. Welsh.) This is this circuit of Exhibit 23-108 was your circuit that Mr. Harrison constructed?

A. I believe that's correct. I think I can find reference to it in one of my notebooks. I did apply for a patent on that circuit after it proved feasible. Would you like me to look for the reference to it?

Q. Not unless you have any doubt about it.

A. No, I do feel, definitely, that that was my idea. It may or may not have been done before by other people, but I was not aware of it at the time. The idea of using the complimentary transistors I feel was mine. Bill Harrison did, definitely, help implement this by building it and helping to choose some of the

** meaning the saw tooth generator of course.*
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values of resistors, capacitors, etc., but I feel the basic concept was mine. What are we trying to prove right now? Are we trying to find out about --

Q. You had found references in your notes to indications that you had conceived the electronic control of spot position, and you thought that there had been implementation of it, and you read from page 55 of Exhibit 18, and I asked you to determine, if you could, from Mr. Harrison's notes whether such implementation had, in fact, occurred.

A. O. K.

MR. WILLIAMS: He had reached page

56.

THE WITNESS: All right. Page 46, which contained the comment of three spot F. F. ball games --

Q. (By Mr. Welsh.) Before you go on in that regard, I noted on page 3 of Exhibit 18 a reference which I think pertinent to the search that you've been making. Do you find such a reference?

A. Yes, and I thank you. At the lower portion of that page in green is written "For ping pong. (3 spots)" The date is 10/18/67, and I think this, essentially,

* 46 or 56? check exhibit. wtr 5/25/76

does, at least to me, convey the concept of what I consider the ping pong game, although it doesn't show at that time full implementation.

Q. Would you state what that concept was as indicated on this?

A. On this page 3?

Q. Yes.

A. All right. There would be three spots, one would represent a ping pong paddle designated "paddle A;" a second, a similar paddle labeled "paddle B." As shown, the paddles moved mainly in a vertical direction. A ball is indicated by a third square. It is shown in two of its positions where it would reside if it were missed in its flight across the screen, that is, if it were not hit by either paddle. In the left margin of that page I see the words "Push button start going to a horizontal flip flop and a vertical flip flop." Apparently, the intent even at that time was that when the reset push button was pushed, the ball would start from, for example, off screen left, traverse toward the right. If it were hit as shown by paddle B on the right, its flight would reverse as indicated by the words on that page "When ball is hit by paddle.

reverses. (Flip flops reset.)" The green writing shown in the lower right-hand corner, page 3, indicates an answer I had given to a previous question by saying that "The players can also control horizontal position of bat.* Faster players can move in closer to net."

That's what I meant before by saying that the horizontal controls weren't used all the time in this game but to set the game for a fast game or a slow game. Is there any other question on that explanation?

Q. Did you comment on the part about player B controls V1 and player A controls V2?

A. Thank you. That is, apparently, what you referred to earlier as an English control in that the player who has just hit the ball gains control of its vertical position during its flight to the other paddle.

Q. Now, could you go back to determine if there are any indications in Mr. Harrison's notes as to implementation of your concepts?

A. All right. I'll start again with Exhibit 23-108, which does appear to be a circuit of the complimentary transistor saw tooth generator which was to be used with the sliced wave form method. Exhibit 23-109 appears to be more work on that same subject.

* meaning "paddle" wtrc 5/25/76

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Q. The saw tooth generation on 109?

A. Let's see. I would say, at least, the lower portion of that figure appears to be that. However, I'd better look at this more closely. I'll start with the upper figure on that page. That does not appear to be the complimentary flip flop in that it does use two NPN transistors. I'm not sure of what the lower schematic represents. It may or may not be a version of this complimentary flip flop. I'm just not sure.

Q. O. K. Any part of it, then, Exhibit 23-109?

A. I'd say, definitely, not the upper part, and I'll be careful on that, too. The way Bill has drawn these things, it is possible that could be it, and I looked at it quickly the second time and saw the two NPN transistors next to each other and figured they couldn't be a complimentary flip flop, but the third transistor, now, which is, also, NPN is up at the top. I would say it appears that upper figure could not be a complimentary flip flop unless Bill inadvertently drew an NPN transistor instead of the other kind. The saw tooth wave form he shows at the collector of the upper transistor indicates this might be a saw tooth generator, and at first glance I assumed it was,

indeed, the same one we were talking about. He may remember far better than I what this was.

Q. At least you are not sure?

A. No, I am not certain.

Q. O. K. Could you go on through his notes for the same period and see if you find any other indication of the implementation of your concepts?

A. I'm now looking at Exhibit 23-110. I think that, possibly, could be an implementation of these concepts in that it would appear that the circuit in the upper left-hand corner might be one of the complimentary saw tooth generators, right below it a second saw tooth generator. The two figures in the upper right-hand corner do contain diodes coming to a common point which might be the slicer diodes, but, as I recall, then, they should point in different directions. Yes, referring to page 48, for example, of Exhibit 18, it appears that those slicer diodes should be connected in parallel and in opposite directions. So in view of that, I would doubt whether the upper right-hand circuits of Exhibit 23-110 are implementations of the slicing function. I think the lower right-hand diagram of that exhibit, at least partly,

involves generation of RF to get signals into the antenna terminals of a T.V. set. I might add, whatever the circuits at the upper right-hand corner of this exhibit indicate, they do appear to be similar to that shown on Exhibit 23-109, which I had a hard time identifying, also.

Q. In which portion of 23-109?

A. The lower portion. For example, to the right of that lower portion of 23-109 are shown two diodes connected to a common point, but they are pointing in the same direction, permits generation of a pulse during the

Q. Otherwise, do I understand you don't know what those circuits are?

A. I am not sure.

Q. I think we can go on, Mr. Rusch. Hopefully, Mr. Harrison will be able to tell us. I just thought that you might be able to recognize from his notes whether any of the material he was working on was related to your concepts.

A. Not really, other than, maybe, those complimentary flip flops if, indeed, that's what they are, in the upper left of 23-110. I do see, now, on Exhibit 23-112 dated 11/9/67, on a piece of paper, apparently signed

by Bill Harrison, reference to ping pong, three spot. I think this may be an indication of his attempts to reduce the slice diode idea into practice. I say that because down near the bottom I see some words saying "Input from differentiator," and a necessary part of the sliced saw tooth method was a differentiator which would give a constant voltage while the saw tooth wave form was rising, for example, and zero voltage when the sliced portion was being taken. We haven't covered this feature yet, but this differentiation, obviously, permits generation of a pulse during the time slicing occurs. This pulse would then be used to control the Z axis or intensity modulation of the electroⁿbeam in order to make a spot appear while the slice was being taken. The lower portion of this exhibit does show what appears to be a summation circuit adding signals from what are labeled spot 1, ball, and spot 2. Exhibit 23-113 appears to be, at least, an attempt at implementing one of the concepts I previously referred to as being one of my contributions as shown on page 43 of Exhibit 18 in that the lower two transistors of Exhibit 23-113 appear to be a flip flop whose state can be controlled by what

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Mr. Harrison labeled as "Trigger N." It can be seen that potentiometers, in this case, four different ones, are connected to the two outputs of the flip flop through eight different diodes similar to that shown conceptually on page 43 of Exhibit 18, dated 11/1/67. The date on Mr. Harrison's schematic of Exhibit 23-113 is 11/10/67 indicating that we were, indeed, at least starting to implement some of the concepts previously referred to. Now, on Exhibit 23-114, appears to be, possibly, an abortive attempt to check feasibility of the automatic reset previously referred to.

Q. When you say "aborted attempt," how did you determine that?

A. I note there's a big pencilled cross through it all.

Q. And is there, also, a similar cross on the upper portion of Exhibit 23-112?

A. Yes, there is. I neglected to mention that. I might add that these crosses on the abortive attempts were, to my recollection, temporary, and we did get these functions working. Let's see. All right. On Exhibit 23-115 Mr. Harrison, apparently, shows a circuit or circuits for what he calls a very low frequency free

running multivibrator, or, as he says, "multi," which I would assume, since it follows so closely the previous exhibit, pagewise, was to be used for a slow automatic reset.

Q. Is that Exhibit 23-115 related in any way to page 54 of Exhibit 18?

A. I would say definitely, and all these exhibits we're discussing, all three of them, have the same date, 11/13/67.

Q. That's Exhibit 23-115, 23-114, and page 54 of Exhibit 18?

A. Yes, Exhibits 23-116, 117 and 118 do, definitely, appear to indicate, to me at least, that the three spot flip flop ball ^gframes referred to on page 56 of Exhibit 18 were indeed in existence by the date shown on that page, 11/15/67. Taking these exhibits one by one, 23-116 appears to be a parts list for TVG, dot generator or generators. As can be seen, the parts list is specific and does include actual values of components such as resistors and capacitors and, specifically, indicates types of transistors and diodes used.

Exhibit 23-117 appears to be a

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cost estimate based on the parts referred to in the previous exhibit, and, indeed, at the bottom of 23-117 appear the words "Three dots, \$4.83," indicating that three dots were, indeed, being generated on or before 11/13/67, which is the date of that cost estimate.

Q. How do you know that the three dots had been generated prior to that time?

A. I don't know one hundred per cent positively, but I would doubt very much if this parts list and cost estimate would have been made by Mr. Harrison unless, at least, a breadboard circuit had been built and proven feasible. I assume this is his work. It was in with his exhibits. The attached third exhibit, 23-118, does, indeed, appear to be a hand-drawn schematic which I feel quite sure was drawn by Mr. Harrison. on that exhibit 23-118.

Q. That does not bear a date by itself, does it?

A. No, nor a signature. It does, however, seem to, definitely, be an implementation of this electronic control diode slice saw tooth wave form concept I've described previously. The upper left-hand circuit diagram of that figure does, at least after some scrutiny, appear to, indeed, be the complimentary

transistor saw tooth wave form. Its outputs, being shown as Hs and Hst, I believe, refer to horizontal sync pulse and horizontal saw tooth, respectively. The circuit right under that, similar in concept but having larger capacitor values, would definitely appear to me to be the circuit for generating vertical sync and vertical saw tooth wave form. The middle circuits on that exhibit definitely appear to be what I think must have been workable, feasible circuits using the diode slicers to generate two electronically movable spots. The upper right-hand corner shows a schematic of what I think would be a low frequency flip flop quite probably used for the automatic reset function discussed earlier.

Q. Now, there are only two spot generators, is that correct, on that Exhibit 23-118?

A. As shown, specifically, on that exhibit, I believe that is correct, although it can be seen that both dot generators appear to be identical, and that more spots could have been generated by making more of these identical circuits.

Q. At least from that exhibit, alone, it is not clear that there were, in fact, three dots?

A. Let's see. I think that is correct.

47 Q. In other words, that's not a complete schematic for the ping pong game, although it may include some circuits which were usable in the ping pong game?

A. I think that's correct, but I would point out, again, that the cost estimate on the exhibit preceding that, to wit: 23-117, does, specifically, say three dots, which, to me, at any rate, might indicate that the third of three identical circuits, just may not have been shown on the circuit diagram.

8 Q. Since the other two exhibits, 23-119 and 23-120, which were connected to 23-116 and 23-117, are not dated -- excuse me, sit at one end of the line --

A. You lost me with all those exhibits. I have three, which appear to be connected together.

Q. Oh, I'm sorry. I thought 119 and 120 were also connected. Is mentioned in the cost estimate.

A. Not at the present time. and 124 are also mentioned.

Q. Oh, you did refer to them, did you not?

A. I don't think so. 1-124, appears to be a parts list.

Q. Oh. O. K. Well, then, I --

A. I doubt it. 1-124, appears to be a parts list.

Q. I just ask you to go on then.

A. All right. I will. I now have Exhibit 23-119, which does have two staple holes in it and may or may not have been connected to something else at one time.

Q. I think since these aren't dated, why don't we just pass on from them, because the question was related to notes of Mr. Harrison that would indicate implementation of the concepts that you had at the time, and while these may be pertinent to those concepts, since they're not dated, I ask that you go on to the next exhibits.

A. O. K. I would add, just for my portion of this record, that if, indeed, they had been attached to the other three exhibits at one time, these latter two, specifically, 23-119 and 23-120, do, indeed, show three spot generators employing the slice diode method, which would, at least, make them consistent with the three spots mentioned in the cost estimate. Now, Exhibit 23-121, 122, 123 and 124 are at the present time all stapled together and in my hands. The first of these, 23-121, appears to be a parts list giving specific transistor types, diode types, resistor values, capacitor values, etc., for the function called at the top of that Exhibit "TVG,

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horizontal and vertical S.T. gen,"(g-e-n.) This would indicate horizontal and vertical saw tooth generators.

Exhibit 23-122 appears to be a cost estimate based on that parts list. Both of these pages are dated 11/14/67.

O. K. Exhibit 23-123 appears to be a parts list without specific values but resulting in a cost estimate for the modulator and transmitter circuit, probably used at the time to put these dots on the T.V. set.

Exhibit 23-124 appears to be the specific parts list containing specific values for the modulator and transmitter and indicated on this exhibit video shaper for the cost estimate of the previous exhibit.

Q. Would you refer, also, to Exhibit 23-125, 126?

A. All right.

Q. Does either of those appear to indicate any implementation of your electronic control of ping pong games?

A. In the upper circuit of 23-125 is labeled "Coincidence detector and trigger generator." Its inputs come, apparently, from what is labeled "Ball, paddle, and

paddle." That is, two paddles. Its output is labeled as going to a one-half cycle per second multivibrator. I would believe, or think, that this had to do with the automatic reset function of the ping pong game. I say that because of the very slow one-half cycle per second multivibrator, which I assume at this time was used for the reset function. Let me think about that for a while. I take that back. In thinking about this I wondered why one would want reset if the ball hit either one of the two paddles, and one would not want reset at such time. The one-half cycle multivibrator, I believe, was effectively the flip flop that reversed the direction of the ball when it hit either paddle.

Q. Would the upper portion of 23-125 represent some implementation of your ping pong game?

A. I would definitely say yes, especially since the three inputs to this coincidence detector are labeled "Ball, paddle, and paddle," which is the nomenclature we and many ping pong players use for objects in that game.

Q. And would the same thing be true of Exhibit 23-126?

A. I would say yes, even though the word -- oh, I do see

paddle, too. In the left-hand column I see a box labeled "horizontal," another "vertical," with the word "ball" outside each box. Under that are two more boxes with P1 beside them. Below that two others with "P2" beside them, and I would definitely believe that the P1 and P2 refer to the word paddle, paddle 1 and paddle 2. Slightly to the right of these boxes in small letters can be seen the words "Horizontal paddle 1, vertical paddle 1, horizontal paddle 2, and vertical paddle 2." Up above them the words "Horizontal ball 1, horizontal ball 1," or just "Ball," I guess, without the 1, yes.

Q. Could you, now, return to Exhibit 18, and last page, you had reached, I believe, was 56, and you were looking for entries that would indicate when the electronic spot control and the ping pong and the wall bounce concepts occurred.

A. All right. Let's see. As far as the ping pong goes, I think you pointed out that back on page 3 of Exhibit 18 that was mentioned, and we discussed the lower half of that page which, I think, at least to my satisfaction, establishes that that concept existed as of that date which was 10/18/67. Now, going further

through that exhibit, which is one of my old notebooks, I find a comment which I believe I wrote on page 75 dated 11/20 which says, "Still greatly need ball direction (and maybe speed and distance) determined by ball hitting it! Be great for pool, ping pong, badminton, soccer, etc. How do?"

This indicates to me that, at least, the feature of a ball moving in the same direction of the spot which hit it and going at a velocity determined by the velocity of the hitting spot had not been implemented either conceptually or with hardware as of 11/20/67.

I think this feature, in my mind at least, is so similar to the wall bounce feature that the latter, probably, didn't exist at that time other than as a desirable item but without specific concept for implementation. The work on the previous page, 74, of that Exhibit 18 also appears to be directed toward that end of making a spot move in a manner determined by the direction and velocity of the spot which hits it.

Q. Now, before you go further, referring back to page 55 of Exhibit 18 --

A. Page 55?

Q. Yes. -- did you in the entry at the top of that page contemplate bouncing of a ball image off of some other image on the TV screen?

A. Yes, as indicated by the green wording at the top of page 55 where I wrote "Moving (controlled) guidelines." And show them in green on that rather sparse figure. I did intend, I am quite sure, that these were not overlay type guidelines, but would be electronically generated and appear on the screen. I say this because I know of no convenient, economical way of telling when a spot on a TV has gone past the guideline on an overlay without using more complex techniques ^{than} that I had in mind at the time this work was being done.

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Q. So that would be similar to the wall bounce if the guidelines weren't moved?

A. I think that's correct. I might also mention, just for what it is worth, at the bottom of that page 55 is shown a bowling game where the ball would hit other spots which would disappear when hit. That's, probably, not germane to what we're talking about, but I guess I said that is an indication that I was, indeed, thinking of electronically controlled guidelines at the

top of that page just as electronically generated bowling pins at the bottom of the page. I think we were coming to page 76 of Exhibit 18, is that correct?

Q. Yes.

A. This page dated 11/20, does, again, seem to be work concentrated on the ping pong game. All right. And I think this is one of the first concrete instances I've come across yet in this deposition of being able to, even conceptually, have a ball move in the direction in which it is hit by a spot. I say this referring to the words "Thus, if hit downward, ball (as shown) ball heads downward, etc. If hit ball at mid-screen and stay there, ball goes across horizontally." The label at the top of this page 76 says, "For ping pong, better control of ball's direction."

Q. Was such a control implemented?

A. Eventually, yes. Before I discuss it too much, I would like to point out the comment at the upper right of page 76 which says, "Now use pots to set V_r , V_l after hit ball." That comment refers to what you referred to as English, controlled manually by the players free hand. This, now, is a new feature which,

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→ corrected to extent
covered by note in Depo 8, p. 47

apparently, I was attempting to develop or conceive as
of 11/20/67. Page 78, dated 11/20, again, shows a
flip flop with several potentiometers connected between
its outputs with diodes. This particular circuit
has been referred to in other pages previous to this
one, and I believe was one of the circuits shown in
Mr. Harrison's exhibits as, probably, being implemented
around this time. The intent of this circuit is ^{as}
indicated at the bottom of page 78 was that flip flop ^{clarity}
would give control of the flight of the ball to the ^{w/12}
player last hitting the ball. ^{5/25/76}

MR. WELSH: I think we'll break
here and resume at 9:30 in the morning.

William T. Rusch *
Deponent 5/28/76

THE STATE OF New Hampshire,)
COUNTY OF Hillsborough) SS.

Subscribed and sworn to before me this 28
day of May, 19 76.

ROSELLA MURPHY, Notary Public

Roseella Murphy
Justice of the Peace and/or
Notary Public